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ABSTRACT

The purpose of this paper is to consider different kinds of actions learners may take during computer assisted instruction (CAI), and to examine the kind of information they need in order to exercise control over the instruction, i.e., information about their performance level, the organization of the content, the choices available to them and the consequences of making those choices, and what they are required to know. Techniques described for providing such information include: (1) content maps, so that learners can navigate their way through content sequence; (2) computer graphics that depict achievement of outcomes; (3) clocks that portray the amount of time spent; and (4) text that conveys the degree of mastery. Other techniques used govern non-content based information, such as switching menus or exiting the program, and dictate the type of feedback the learner will receive. Hypermedia programs are used to illustrate how this information can be communicated to learners to promote intelligent and effective learner control in CAI. It is noted that some learner controlled instruction has the potential to lose learners in too much detail and too many layers. Thus, course organization and programming must be constructed with the learner's information needs in mind. (7 references) (DB)

Learner Decisions and Information Requirements in Computer-Based Instruction

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Much has been written about screen design for computer-based instruction (CBI) programs (e.g., Allesandrini, 1984; Hannafin & Peck, 1988). Authors of CBI programs should make their screens clear, consistent, and appropriate we are told in order to aid learners. But as authoring tools and navigational methods inherent to those tools become more sophisticated, so do CBI programs. It is now necessary to consider not only how the information needs to be presented, but also how learners will access the information in a program.

The range of choices available to learners in computer-based learning environments seems to grow exponentially. The choices referred to here are not about what program to study but rather choices and decisions within the programs themselves. The ubiquitous *Press any key to continue* to control the pace of a lesson has been expanded to include choices and decisions relating to amount and kind of practice, sequence of topics to study, amount of presentation materials to interact with, when to be tested, whether to see elaborations on incorrect responses, or what facet of a program to explore.

CBI programs, like any other type of instruction, are capable of providing a wide array of learning situations. From linear tutorial programs to exploratory hypermedia environments, CBI can offer the learner a range of learning settings suitable to the needs of learners and the goals of the course. But as the richness of a learning environment grows, so do the choices available to a learner and, consequently, the amount and kind of information needed in order to successfully accomplishing course goals.

Many factors must be considered during the instructional development process: learning outcomes (Gagné, Briggs, & Wager,1988), entry behaviors (Dick & Carey, 1990), and the strategies of instruction. A classroom instructor must make decisions about how to go about presenting the material to a learner. In the same way, designers of CBI must make decisions about how information should be presented to learners, or how learners will access information within a CBI program. Much has been written about the role of the learner in CBI, but the learner can only access what is present in the instruction. The designer of CBI programs makes the decisions about what information will be presented in a CBI program in the same way that a teacher makes the decisions about what information will be presented in a classroom lesson. Additionally, the structure of how the learner may access the information available is also the responsibility of the designer.

The interface of a CBI program will determine how the learner accesses information. Will the learner "press the space bar to continue," or choose from a variety of options on a computer screen? Information must be accessed in a way that is easy for the learner to understand, and in a fashion that matches the learning style of the learner. While "proper" screen design places information on the screen in a desirable and readable manner, "proper" interface design should allow the learner to access the information in a comfortable, logical manner. But comfort and logic vary from learner to learner. The decision on the part of the designer as to how the learner will access the information is influenced by two variables: the actions of the learner and the information needed to take appropriate action.

Information needs

Computer-based instruction can offer the learner a variety of rich and choiceful environments. Depending on the learning outcome involved in an instructional package, the learner may or may not need to make many choices as a program progresses. For example, if the learner is expected to demonstrate verbal information skills, such as identifying the fifty states on a map, it may be sufficient to use a linear approach to the CBI module. However, if the learner is expected to demonstrate problem solving skills, as

in the case of Joe Henderson's *Combat Trauma* (a program designed to help physicians react to battlefield casualties), then a richer more choiceful environment is required. In this situation, it is highly desirable to have the learner explore and make decisions, both right and wrong, in a safe environment. Hence, the degree of choicefulness within a CBI program is directly related to the purpose of the program.

In a highly choiceful CBI environment, it does not take long for the learner to become lost in a maze of program layers, and confused by a host of decisions. It is therefore desirable for the designer to include such measures as to let the learner know how he or she is progressing in the program. The front end of many pieces of CBI usually includes a list of icons present in the program, what those icons mean, and how to use them. Maps of the structure of programs have long been used to let the learner know where they are in the program. Apple Computer® uses maps in many of their programs that tell the learner where they have been, where they are, and how to get to where they want to be within a program (see Figure 1). Peters (1988) took the idea further by giving learners a variety of kinds of visual and verbal feedback and information during a CBI program to offer learners both navigation and performance information (see Figure 2).

Actions of learners

How do learners relate to programs that provide options concerning navigation, course content, assessment, and feedback? What types of interfaces work better with different types of learners? If you go through a hundred different programs, chances are that you will use a hundred different interfaces. Arrows are used in HyperCard programs, and a variety of other different prompts are used in other programs. For someone who has experience in a variety of CBI environments, it is usually possible to figure out what gets you where. But to the inexperienced CBI user these things are neither obvious, nor intuitive. Icons in one program may have entirely different meanings in other programs, and the meaning of them is nearly always determined by the designer of the program.

Choices and Control in CBI

How to respond intelligently to the bewildering range of choices and decisions provided in some computer programs is heavily dependent on the information available to a learner. In order to respond sensibly to a choice of whether to do or not to do more practice, the learner needs information about his or her performance level. To make intelligent choices about what to study next, the learner should have knowledge of the organization of the content and what has already been studied. In order to make reasonable choices about whether to see elaboration on answers it is necessary to know what the various elaborations are.

Learners are required to guide their own learning at least to some extent in many computer programs and, therefore, need information that allows them to regulate and oversee their own actions. Intelligent and effective choices and decisions in computer learning environments are based on having sufficient information about the choices available and the consequences of making them. Metacognition, the monitoring and regulation of learning, is concerned with both knowledge about and regulation of learning. Thus, learners provided with choiceful behavior in a computer-based learning environment, need knowledge about what they know and what is required in order to successfully regulate their own learning activities (Schmitt & Newby, 1986).

All computer learning environments do not provide the same amount or kind of choices and decisions to learner, nor should they. The amount of choice provided to learners may depend on --

- characteristics of the learners -- their age, experience, or ability level may influence what choices are suitable. Younger, less experienced, and lower ability learners may require more structured learning environments with fewer choices.
- nature of the topic -- is the learning highly sequential or composed of critical skills? Certain topics, for example in mathematics learning, are highly sequential and need to be learned in a certain order. Other skills, for example those associated with safety or life, may

provide no margin for error in learning. As a result, less choice in what is learned or how well a learner achieves is required.

- purpose of the learning -- is the learning recreational, job-related, or important for continued academic progress? If participation in the learning is itself a matter of choice, then free choice of how to proceed may be left to the learner. But, if it is essential that certain knowledge and skills be acquired, the choices provided to learners may be proscribed in order to achieve desired ends.

Conclusions and Recommendations

Allowing learners to make choices with computer-based learning is neither good nor bad, wise nor unwise, or desirable nor undesirable. Some learning settings can and should allow wide ranging choices to learners and some should not. It is even possible to have the kind and amount of decisions made by learners dynamically vary within programs depending on such factors as the progress and success of learners, the degree of progress through instructional materials, and the changing nature of the tasks to be learned (Johansen & Tennyson, 1983).

The design of an interface for a program should depend on the amount of choicefulness designed into it. The amount of choice should determine how the program is structured by the designer, and accessed by the learner. Providing information and choices in an interface is not intended to stifle the creativity of the CBI design and development process any more than chapters, page numbers, quotation marks and other standards for print media stifle an author. But when a reader picks up a book, he or she can look at a table of contents, know where the information needed lies within a large volume, and get to that information with little effort. CBI programs could profit similarly from an interface that provides similar information and opportunity for choice.

Additionally, interfaces need to include information accessible to the learner that details not only how to move through the program, but how well the learner is doing in the program. Information on navigation, student

progress, and lesson structure need to be available to the learner throughout an instructional program.

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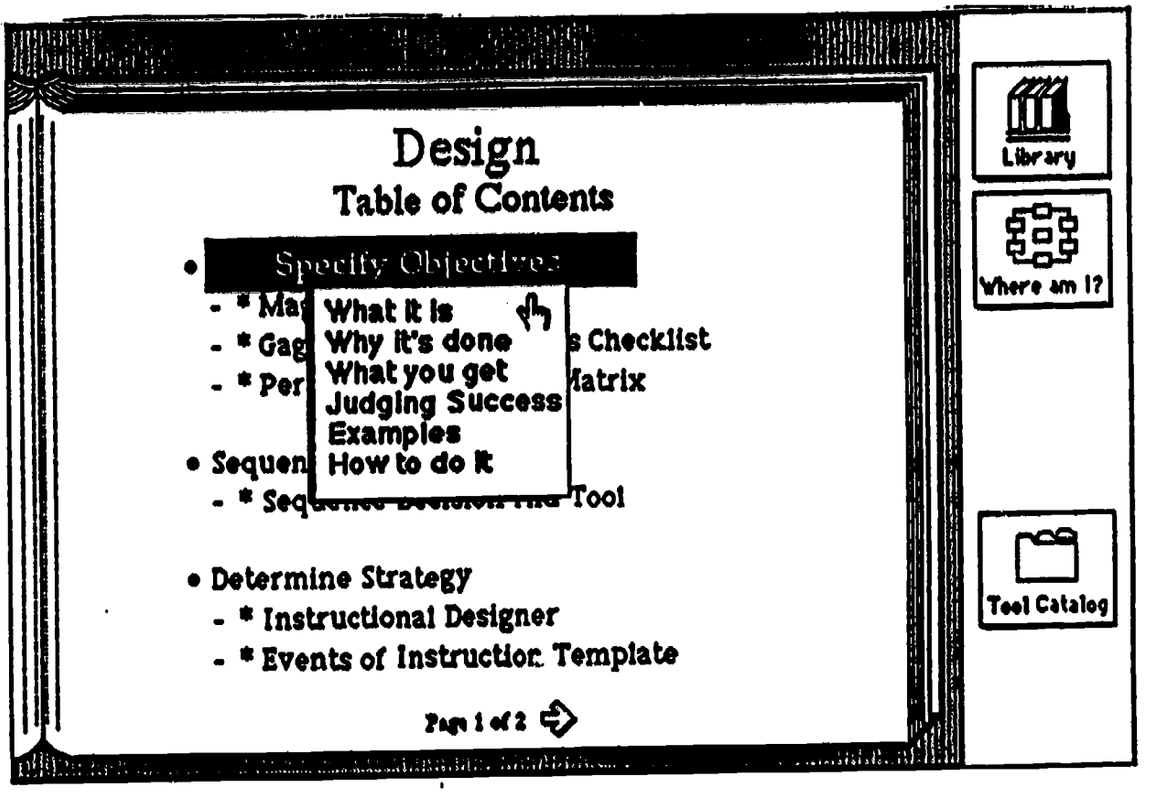

Figure 1. A screen in an exploratory learning environment.

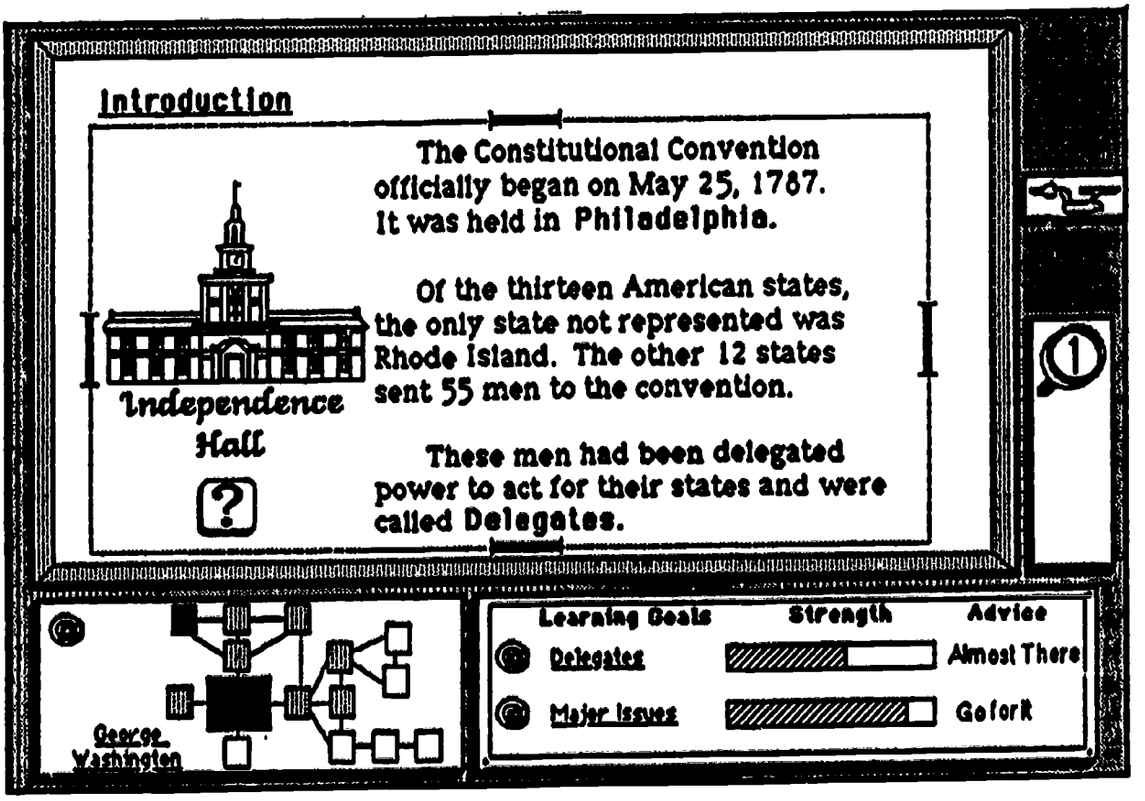

Figure 2. A screen showing navigational aids and information sources in a CBI program (from Peters, 1988).